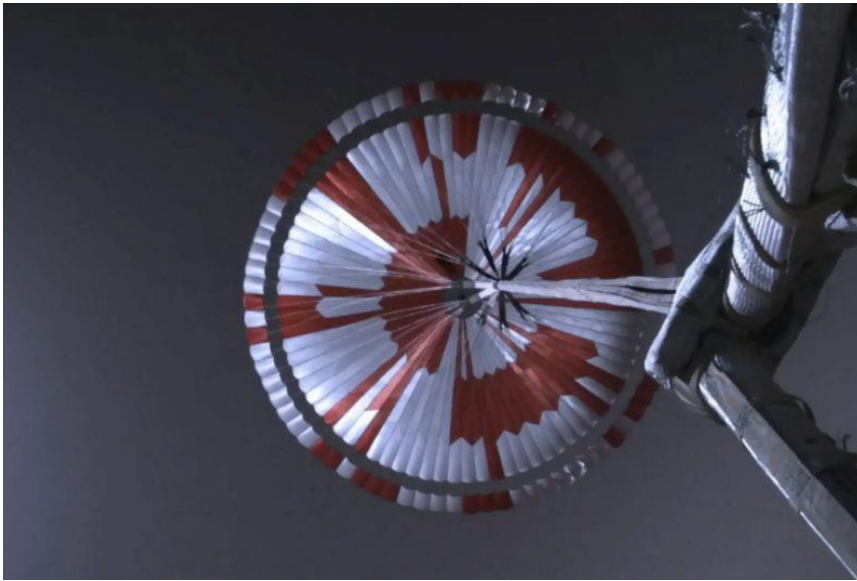


Day98 Decimal to Binary Conversion  
Due Friday 5/12/23

Did you hear a few years ago about how NASA's Mars rover's parachute had a hidden message encoded in binary on it? Here is a picture of it:



Here's a [link](#) to an article about it if you want to read more.

Today you're going to write a program that takes user-entered text and then prints out that text in ASCII and then binary format. Here is sample output:

```
Please enter a message to convert to binary: Go Tigers!  
  
GO TIGERS!  
  
G   71  1000111  
O   79  1001111  
   32  0100000  
T   84  1010100  
I   73  1001001  
G   71  1000111  
E   69  1000101  
R   82  1010010  
S   83  1010011  
!   33  0100001
```

What you see above is that I typed in a message, and then my program converted the message to call caps, then it printed out each letter, along with its "ASCII" encoding (the middle column), and its binary encoding. You're going to write all of this. It's actually easier than you might think.

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Step 1:

Make a Scanner. Ask the user to enter a phrase. Remember, you have to say "import java.util.Scanner" at the top of the program.

Step 2:

Make the message uppercase (use toUpperCase()). Print the upper case version.

Step 3:

Make a for loop that goes from 0 to one less than the length of the message (use message.length()). Inside the for loop print each letter, followed by a tab, and then the number version of the letter, followed by the word "binary" as a placeholder for now.

You can do this like this:

```
System.out.print(message.charAt(i)+"\t");
System.out.print((int)message.charAt(i)+"\t");
System.out.println("binary");
```

If your message is in a variable called "message" you can just copy the above three lines and paste them into your for loop.

What is going on here? Well, there's a String method .charAt() which grabs a single character and returns it as a char, which is a primitive variable type that holds only one letter. We haven't used .charAt() before this year because it is not in the AP spec. The second line above converts that char (the letter) to its integer version. So the letter A becomes 65, B becomes 66, and so on. This is using the ASCII encoding system (here's a [link](#) to more on that if you want to read about it, this is optional.)

OK, so this does more than half the work for this assignment. If you typed in "abc" for the message, your code would now print this:

```
Please enter a message to convert to binary: Go Tigers!

ABC

A 65 binary
B 66 binary
C 67 binary
```

Step 4:

Write a method called "decimalToBinary" that converts an int to a binary String. I recommend starting with this structure:

```
public static String decimalToBinary(int n)
{
    String temp = "";
    return temp;
}
```

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For our purposes, we'll assume that  $n$  will be less than 128. Make an empty String variable called `temp`, and add the binary digits as Strings to it one at a time (either 1 or 0) until you've converted the number completely, then return `temp`. I set up the basic structure for you above.

If I have a number  $n$  that is less than 128 that I want to convert to binary, I would follow this process:

1. Divide by 64 (this is 2 to the 6th). Since we're doing integer math, we'll get 1 if  $n$  is larger than 64 or 0 if  $n$  is less than 64. This is the first digit of our binary result.
2. Next, we replace  $n$  with  $n\%64$ . This "divides out" the 64, leaving us with the remainder.
3. Next, we divide by 32, which is 2 to the 5th. This gives us our next digit. Then we replace  $n$  with modulo 32.
4. We repeat this with 16, 8, 4, 2 and 1 and we're done.

I used `(int)Math.pow(2,x)` to get my powers of two. I started with 6 and went down to 0. The `(int)` is because `Math.pow()` returns a double, and when you divide by a double, your answer is a double. For this routine we want int answers.

[Here is a link to a website explaining how to do this more generally](#) (I gave you this link the other day, too.)

After you have the method working, change the line that was printing "binary" to this:

```
System.out.println(decimalToBinary(message.charAt(i)));
```

The above line sends the current character over to the new method you just wrote and then prints the result.

Enter "Go Tigers!" and you should get this:

```
Please enter a message to convert to binary: Go Tigers!
```

```
GO TIGERS!
```

```
G 71 1000111
O 79 1001111
 32 0100000
T 84 1010100
I 73 1001001
G 71 1000111
E 69 1000101
R 82 1010010
S 83 1010011
! 33 0100001
```